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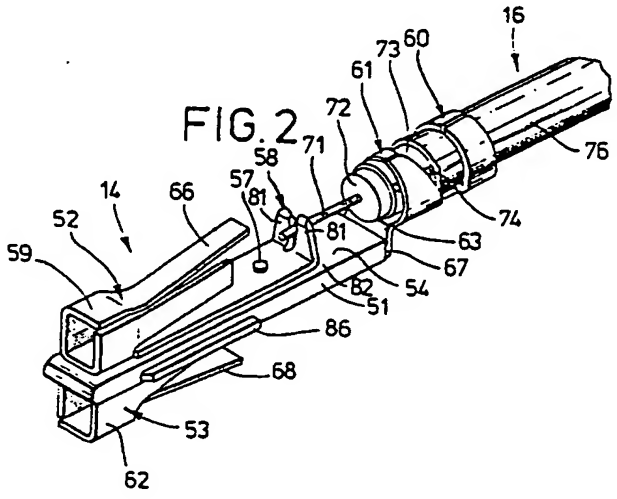
(54) High-density, modular, electrical connector.

(57) A high density, electrical, connector for discrete wire coaxial cables includes one or more housing modules (21a, 21b, 21c, 121), adapted to receive one or more termination members (14, 126a, 126b) attached to the ends of coaxial cables (16, 116). Each termination member comprises a dielectric support (51, 134) having a signal contact (52, 142) supported on one side thereof and a ground contact (53, 131) supported on the opposite side thereof. The contacts include first and second connections (58, 61) on the same side of the support (51, 134) and substantially aligned with one another and with the cable. The ground contact (53, 131) includes a third crimp connection (60), aligned with the first and second connections (58, 61) and the cable.

FIG. 2



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HIGH-DENSITY, MODULAR, ELECTRICAL CONNECTOR

The present invention relates generally to electrical connectors and, more particularly, to high density, electrical connectors for discrete wire coaxial cables

A discrete wire coaxial cable comprises a center, signal carrying conductor, an outer, electrically conductive foil to provide shielding, and a drain wire connected to the foil to maintain the foil at a reference potential.

A high density, electrical connector is a connector that terminates a large number of discrete wire cables to corresponding contacts that are spaced from one another in a relatively small area.

A known connector is disclosed in U.S. Patent 4,449,381 and comprises, a cable having multiple conductors connected to corresponding electrical contacts. The conductors are bent for routing the conductors from the cable to the corresponding contacts. The contacts extend along a carrying portion of an insulative housing. Due to bending of the wires apart from one another and due to wide spacing apart of the contacts in the housing, the housing has a relatively wide width. A wide width housing is too bulky for a high density connector.

The present invention provides a high density, electrical, connector for discrete wire coaxial cable systems which can be efficiently manufactured and assembled and which provides flexibility in design for use in diverse applications. The connector is particularly designed for terminating discrete wire coaxial cables comprising a center, signal carrying conductor, an outer electrically conductive foil for shielding, and a drain wire electrically connected to the foil for maintaining the foil at a reference potential; and includes a termination member mounted to each of one or more cables and a connector housing for receiving the one or more termination members.

Each termination member includes a signal contact and a ground contact which are mounted on opposite sides of a dielectric support. When the termination member is positioned in the connector housing, the dielectric support functions as a housing wall to electrically isolate the contacts from one another. The first and second cable termination portions of the contacts, however, are positioned substantially in alignment with one another and with the cable such that the center conductor and drain wire of the cable can be attached to the contacts without it being necessary to bend or otherwise reroute them, permitting the attachments to be made more rapidly and with less risk of damage to the fragile center conductor and drain wire.

In accordance with a further aspect of the invention, each termination member can be inserted into or removed from the housing for servicing or replacement without disturbing other circuits in the connector. The housing comprises an assembly including one or more housing modules each having one or more termination member receiving passageways. This modular construction provides substantial flexibility in forming connectors of diverse shape and size for different applications.

The ground contacts of adjacent termination members can be oriented within the connector housing to permit both to be electrical connected to a single ground contact in a mating connector. This alternative construction permits an increase in connector density without increasing the complexity of the connector.

Further advantages of the invention will become apparent by way of example from the following detailed description taken in conjunction with the drawings.

Fig. 1 is an exploded, perspective view of a high density, electrical connector according to a presently preferred embodiment of the invention;

Fig. 2 is a perspective view illustrating the termination member of Fig. 1 attached to the end of a discrete wire coaxial cable;

Fig. 3 is a cross sectional side view of the connector of Fig. 1 in assembled form;

Fig. 4 is a perspective view illustrating termination members according to an alternative embodiment of the invention;

Fig. 5 is a cross sectional side view of a connector incorporating the termination members of Fig. 4; and

Fig. 6 schematically illustrates an improved method for manufacturing termination members according to the present invention.

Fig. 1 is an exploded, perspective view of a high density, modular, electrical connector according to a presently preferred embodiment of the invention. The connector is generally designated by reference numeral 10 and includes a plurality of termination members 14 (only one of which is shown in Fig. 1), and a connector housing 12 for receiving and supporting the plurality of termination members. Each termination member 14 is adapted to be attached to the end of an electrical cable generally designated by reference numeral 16.

Connector housing 12 comprises an assembly which includes a plurality of housing modules 21a, 21b, and 21c, an upper cover 22, and a lower cover 23. Each housing module 21a, 21b, and 21c comprises a molded, plastic component designed to receive one or more of the termination members 14. In the embodiment illustrated in Fig. 1, module 21a is configured to receive a single termination

member; module 21b is designed to receive two termination members; and module 21c is designed to receive at least five termination members. In the embodiment of Fig. 1 also, the three modules 21a, 21b and 21c are positioned in side by side relationship, and upper and lower covers 22 and 23 are sized to cover and connect the three modules to complete housing assembly 12. It should be understood, however, that the housing assembly of Fig. 1 is intended to be exemplary only. The housing modules can be manufactured in any desired size and arranged in any desired manner to form connector housing 12. In general, the modular construction of the housing permits connectors of any desired size or configuration to be custom designed and quickly assembled from a limited number of standard modules and cover sizes depending on the requirements of particular connector applications.

Modules 21a, 21b, and 21c each include a pair of outer sidewalls 26 and a front wall 27a, 27b, and 27c, respectively. Modules 21b and 21c additionally include one or more intermediate sidewalls 37. The outer sidewalls 26 and/or the intermediate sidewalls 37 define passageways 36 therebetween for receiving termination members 14 as will be explained hereinafter. Outer sidewalls 26 of the modules are one half the thickness of intermediate sidewalls 37 such that when the modules are positioned in side by side relationship as shown in Fig. 1, the abutting outer sidewalls 26 of adjacent modules will have a combined thickness equal to the thickness of intermediate sidewalls 37 such that the termination members will be uniformly spaced within the assembled connector housing 12.

Passageways 36 extend from the front walls 27a, 27b, 27c of the modules to the open back ends 28a, 28b, 28c thereof. The front walls of the modules include horizontal web portions 30 which define upper and lower apertures 33 and 34 aligned with each passageway 36 in the modules. The modules are substantially open on their top and bottom except for top and bottom wall portions 29 and 31 which extend rearwardly from the front walls thereof.

Upper and lower covers 22 and 23 are identical in shape and comprise substantially flat plates of plastic. Covers 22 and 23 each include a plurality of integral finger elements 41 extending forwardly from the front edge thereof and a plurality of apertures 42 adjacent the back edge thereof. Finger elements 41 and apertures 42 function to position and mount the covers to the modules during assembly of housing 12. More particularly, when the covers are mounted to modules 21a, 21b, and 21c, the plurality of finger elements 41 extend beneath rear edges 43 of upper and lower wall portions 29 and 31 of the modules (see Fig. 3); and the plurality of apertures 42 is positioned to receive a plurality of raised portions 44 on the top edge of the outer and intermediate sidewalls of the modules adjacent the back ends thereof. After being mounted onto the modules, the covers are preferably welded or otherwise bonded to the modules to complete the connector housing. When assembled, connector housing 12 comprises a rigid connector body which is mateable with a complementary connector (not shown) to complete electrical circuits through the connector.

As shown in Figs. 1 and 3, covers 22 and 23 also include a plurality of retention features 46 for releasably retaining termination members 14 within passageways 36 of the modules, and outer sidewalls 26 and intermediate sidewalls 37 of the modules include internal longitudinal grooves 48 for orienting termination members 14 within the passageways as will be described more fully hereinafter.

Termination member 14, illustrated in greater detail in Fig. 2, comprises a flat, rectangular shaped base or dielectric support 51, a signal contact 52, and a ground contact 53. Base 51 comprises a rigid, dielectric material such as glass filled thermoplastic; and contacts 52 and 53 are mounted to upper and lower surfaces 54 and 56, respectively, of base 51 by plastic rivets 57 or other suitable fastening structure.

Signal contact 52 includes a center conductor termination portion 58 adapted to be attached to the center conductor 71 of a discrete wire coaxial cable 16, and a mating portion 59 adapted to mate with a signal contact in a complementary connector when the connectors are mated. Ground contact 53 includes a drain wire termination portion 61 adapted to be attached to the drain wire 74 of cable 16, and a rating portion 62 adapted to mate with a ground contact in a complementary connector. Ground contact 53 additionally includes a cable retention portion 60 for engaging the outer jacket 76 of cable 16 to attach the cable to termination member 14 and provide strain relief for the center conductor and drain wire of the cable. Cable retention portion 60 and drain wire termination portion 61 are formed on a portion 63 of ground contact 53 which extends beyond the back edge 67 of base 51.

Mating portions 59 and 62 of signal and ground contacts 52 and 53 are substantially identical in the embodiment of Figs. 1-3 and comprise generally rectangular shaped receptacles for receiving plug contacts in a complementary connector to complete electrical circuits through the connectors.

Termination members 14 are adapted to terminate discrete wire coaxial cables 16. Each cable 16 includes a central signal carrying conductor 71 surrounded by a layer of insulation material 72, an

electrically conductive foil 73 for shielding, and an insulating outer layer or jacket 76. Cable 16 also includes a drain wire 74 electrically connected to foil 73 to maintain the foil at a reference potential, usually ground.

Before attaching a cable 16 to a termination member 14, the cable is first prepared, as shown in Fig. 1, by removing a portion of cover 76 to expose portions of foil 73 and drain wire 74. A lesser portion of inner insulation layer 72 is then removed to expose the center conductor 71. To attach a termination member 14 to the end of a cable 16, the end of the cable is first positioned on extended portion 63 of ground contact 53 such that jacket 76 is adjacent cable retention portion 60 and the exposed drain wire 74 is adjacent drain wire termination portion 61. When the cable is so positioned on extended portion 63 of ground contact 53, exposed center conductor 71 is aligned with and extends to center conductor termination portion 58 of signal contact 52 as shown in Figs. 2 and 3. Center conductor termination portion 58 comprises a pair of upwardly extending fingers 81 adjacent the rear end of signal contact 52 defining a narrow slot 82 therebetween through which the center conductor 71 extends. The center conductor is wedged in and along the slot 82 to form an electrical connection. Drain wire termination portion 61 and cable retention portion 60 each comprise crimps 61,60, respectively, which are adapted to be crimped over the drain wire and around the cable jacket, respectively.

When cable 16 is properly positioned on termination member 14, crimp 60 is crimped around cable jacket 76, crimp 61 is crimped around cable 16 over exposed drain wire 74, and center conductor 71 is inserted into narrow slot 82 in portion 58.

Crimp 60 applies a pressure crimp around jacket 76 and functions to mechanically attach termination member 14 to the end of cable 16 and to provide strain relief for the center conductor and drain wire connections. Crimp 61 does not apply a pressure crimp around the fragile drain wire 74, but instead comprises an O crimp around cable 16 which "captures" the drain wire therein. Reliable electrical connection of the drain wire to the ground contact is provided by a solder connection. In particular, a thin coating of solder is applied to crimp 61 and, after crimping, the solder is softened to electrically connect the drain wire to crimp 61 and, hence, to ground contact 53. A pressure crimp may be used for attaching the center conductor to signal contact 52, although a solder bond can also be provided if desired to supplement the pressure crimp.

As shown in the Figs., extended portion 63 of ground contact 53 extends upwardly around rear edge 67 of base 51 and rearwardly such that crimp connections provided by the crimps 60 and 61 on ground contact 53 are positioned on the same side of base 51 as connection 58 on signal contact 52. Thus, in the present invention, all three connections 58, 60, and 61 are substantially aligned with one another and with the cable 16. Alignment of the connections simplifies attachment of the termination member to the cable for increased manufacturing efficiency. Also, because the drain wire and center conductor termination portions of contacts 53 and 52 are aligned with the cable, it is not necessary to bend or otherwise reroute the drain wire and/or the center conductor for connection to the contacts. With the termination member of the present invention, reliable, electrical and mechanical connection of the cable to the termination member is achieved without it being necessary to encapsulate the connections in a molded body as in prior systems.

To complete the connector of the invention, the termination members 14 are inserted into termination member receiving passageways 36 of housing 12 from the open rear end of the modules as indicated by arrow 90 in Fig. 3. Insertion continues until the front ends of bases 51 impinge upon central web 30 of front wall 27 of a module. When the termination members 14 are fully inserted into passageways 36, removal thereof is prevented by retention features 46 on upper and lower covers 22 and 23 engaging spring fingers 66 and 68 on the signal and ground contacts, respectively. Removal of any termination member from housing 12, however, can easily be accomplished by simply inserting an appropriate tool into the back of the modules and deflecting appropriate retention features 46 on upper and lower covers 22 and 23 out of the way to free the termination member.

As shown in Figs. 1 and 2, bases 51 of termination members 14 include longitudinal ribs 86 on either side thereof which are adapted to be received within grooves 48 in the outer and intermediate sidewalls of the modules to orient the termination members within the modules and to prevent the modules from rotating. When the termination members are positioned in housing 12, the mating contact portions 59 and 62 of the signal and ground contacts 52 and 53 are aligned with upper and lower apertures 33 and 34 in the front wall of the modules for mating with the contacts of a complementary connector. In addition, the support plate 51 of each termination member becomes an internal wall of the housing to electrically isolate the signal and ground contacts 52 and 53 from one another.

Figs. 4 and 5 illustrate a high density, electrical connector 100 according to an alternative embodiment of the invention. Connector 100 includes a plurality of termination members 126a, 126b adapt-

ed to terminate discrete wire coaxial cables 116, and a connector housing 112 composed of one or more housing modules 121, and top and bottom covers 122 and 123. Housing 112 in connector 100 is similar to housing 12 in connector 10 except that the housing modules 121 are somewhat higher to define higher termination member receiving passageways 141, and include three vertically arranged openings 122, 123, 124 in the front walls 125 thereof.

Termination member receiving passageways 141 are each adapted to receive two termination members 126a and 126b positioned one above the other as shown in Figs. 4 and 5. Termination members 126a and 126b are identical to one another and differ from termination member 14 in the embodiment of Figs. 1-3 only in the configuration of the mating portion 132 of ground contact 131. Specifically, mating portion 132 comprises a spring finger which extends outwardly and forwardly from surface 133 of dielectric base 134 of the termination member as shown in Figs. 4 and 5. In other respects, termination members 126a and 126b are similar to termination member 14 and are electrically and mechanically attached to the ends of cables 116 in the same manner as in the embodiment of Figs. 1-3.

As shown in Fig. 5, termination member 126a is inserted into the upper portion of termination member receiving passageway 141 of module 121; and termination member 126b is inserted into the lower portion of the same passageway 141. Termination member 126b, however, is inserted into the passageway in an upside down orientation such that adjacent ground contacts 131 on the two termination members face each other.

The outer and intermediate sidewalls of modules 121 preferably include two longitudinal grooves (not shown) positioned to receive ribs 146 on bases or dielectric supports 134 of termination members 126a and 126b for positioning of the termination members in passageway 141.

When termination members 126a and 126b are positioned in a passageway 141, the mating portion of signal contact 142 of termination member 126a is aligned with upper opening 122 in front wall 126, and the mating portion of signal contact 142 in termination member 126b is aligned with lower opening 124. The mating portions 132 of ground contacts 131 of the two termination members are both aligned with central opening 123 and serve as resilient fingers to engage a conductive post contact, not shown, adapted for plugging into the opening 123. In this position, both ground contacts can be simultaneously electrically engaged by a single mating post contact extending through opening 123. Thus, in the embodiment of Figs. 4 and 5, the ground contacts of two termination members share the same opening 123 in housing 112, permitting a reduction in the size of the housing and an increase in connector density.

Fig. 6 schematically illustrates a further important feature of the invention. The termination members of the present invention are particularly suitable for high volume, mass production manufacturing procedures. As shown in Fig. 6, a plurality of dielectric termination member bases 201 can be manufactured in continuous strip form, using conventional injection molding procedures. The signal and ground contacts (schematically represented at 202) can be mounted to opposite sides of the bases while they are in strip form; and the bases separated from one another only when ready for attachment to cables. Manufacture of the termination members of the present invention can thus be accomplished more efficiently and with a greater degree of automation than in prior high density connectors.

It should be recognized that the invention could take numerous other forms. Accordingly, it should be understood that the invention should be limited only insofar as is required by the scope of the following claims.

Claims

1. An electrical connector for coaxial cable comprises, a conductive signal contact (52,142) having a corresponding terminating portion (58) for connection to a signal carrying conductor (71) of a coaxial cable (16,116) a conductive ground contact (53,131) having a corresponding terminating portion (61) for connection to a ground conductor (74) of a coaxial cable (16,116) a dielectric support (51,134) supporting the signal contact (52) and the ground contact (53), the signal contact (52) and the ground contact (53) and the dielectric support (51) comprising a termination member (147,26a,126b) and a housing (12,112) for receiving the termination member (14,126a) characterized in that:

the terminating portions (58,61) are in alignment with each other on the dielectric support (51) prior to receipt of the termination member (14,126a) by the housing (12,112a), a portion of the termination member (14,126a,126b) is constructed for positioning a coaxial cable (16,116) in alignment with the terminating portions (58,61), and the terminating portions (58,61) are positioned with respect to said portion of the termination member (14,126a) for connection to corresponding signal carrying and ground conductors (71,74) of a coaxial cable (16,116) without a need for the corresponding signal carrying and ground conductors (71,74) to be bent for routing to the terminating portions (58,61).

2. In an electrical connector as recited in claim 1, wherein the improvement further comprises; different sides of the dielectric support (51) mounts the signal contact (52) and the ground contact (53), and the terminating portion (61) of the ground contact (53) is positioned at the same one of said sides as is positioned the terminating portion (58) of the signal contact (52).

3. In an electrical connector as recited in claim 1, wherein the improvement further comprises; spaced apart walls (26,37) of the housing (12), the dielectric support (51) engages the spaced apart walls (21,37) and forms a wall (51) of the housing (12) separating said signal contact (52) from said ground contact (53).

4. In an electrical connector as recited in claim 1, wherein the improvement further comprises; a cable retention portion (60) positioned on said termination member (14) in alignment with said terminating portions (58,61), said portion of the termination member (14) is constructed for positioning a coaxial cable (16) in alignment with the terminating portions (58,61) and in alignment with the cable retention portion (60).

5. In an electrical connector as recited in claim 1, wherein the improvement further comprises; a conductive second signal contact (142) having a terminating portion (58) for connection to a corresponding signal carrying conductor (41) of a second coaxial cable (16), a conductive second ground contact (131) having a terminating portion (61) for connection to a corresponding ground conductor (74) of a second coaxial cable (116), a second dielectric support (134) for supporting the second signal contact (142) and the second ground contact (131) in said housing (112), with the second ground contact (131) and the first recited ground contact (131) facing each other in said housing (112.).

6. In an electrical connector as recited in claim 1, wherein the improvement further comprises; a first opening (122) in the housing (12) for alignment with the first recited signal contact (142), a second opening (124) in the housing (112) for alignment with the second signal contact (142), and a third opening (123) in the housing (112) for alignment with both the first recited ground contact (131) and the second ground contact (131).

7. In an electrical connector comprising first and second termination members (126a,126b) supporting corresponding signal contacts (142,142) for connection to corresponding signal carrying conductors (71,71) of coaxial cables (116,116), and supporting corresponding ground contacts (134,134) for connection to corresponding ground conductors (73,73) of coaxial cables (116,116), and a housing (112) for receiving the termination members (126a,126b) support the signal contacts (142,142) and the ground contacts (134,134) before the termination members (126a.126b) are received in the housing (112), and the termination members (126a,126b) support the ground contacts (134,134) facing each other in the housing (112).

8. In an electrical connector as recited in claim 7, wherein the improvement further comprises; first and second openings (122,124) in the housing (112) for alignment with the corresponding signal contacts (142,142), and a third opening (123) in the housing (112) between the first and second openings (122,124) and for alignment with the ground contacts (131,131).

9. In an electrical connector as recited in claim 7, wherein the improvement further comprises; a terminating portion (58,58) of each of the signal contacts (142,142) for connection to a corresponding signal carrying conductor (71,71), a terminating portion (61,61) of each of the ground contacts (67,67) for connection to a corresponding ground conductor (74,74), and a portion of each termination member (134,134) is constructed for positioning a coaxial cable (116,116) in alignment with a corresponding terminating portion (58,58) of the signal carrying conductor (71,71) and a corresponding terminating portion (61,61) of the ground conductor (67,67), and the terminating portions (58,58,61,61) are positioned with respect to the portion of the termination member (134,134) for connection to corresponding signal carrying and ground conductors (71,71,74,74) of a coaxial cable (116,116) without the need for the corresponding signal carrying and ground conductors (71,71,74,74) to be bent for routing to the terminating portions (58,58,61,61).

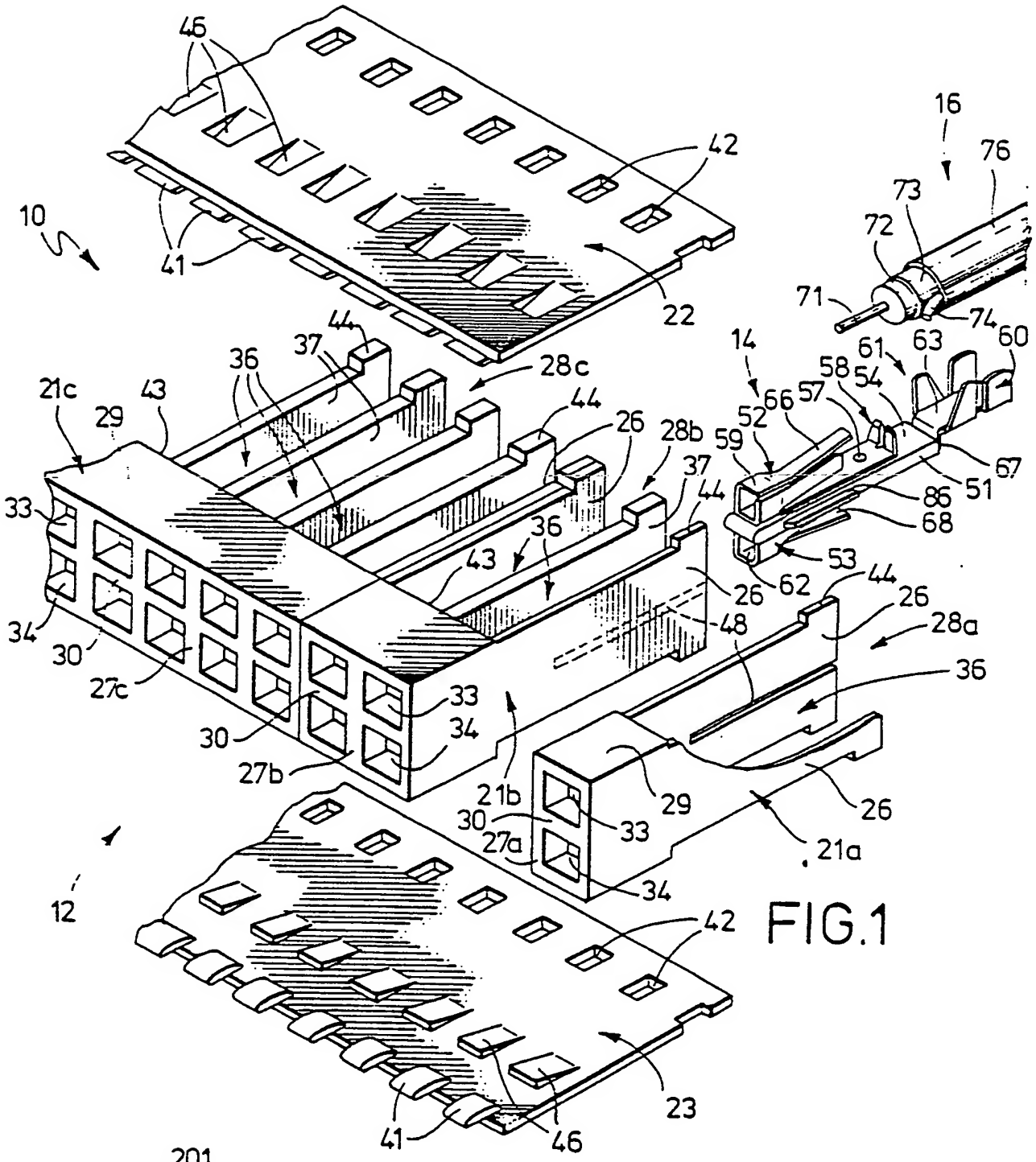

FIG.1

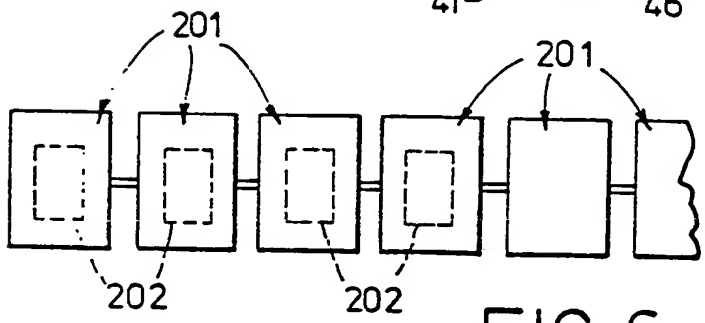

FIG.6

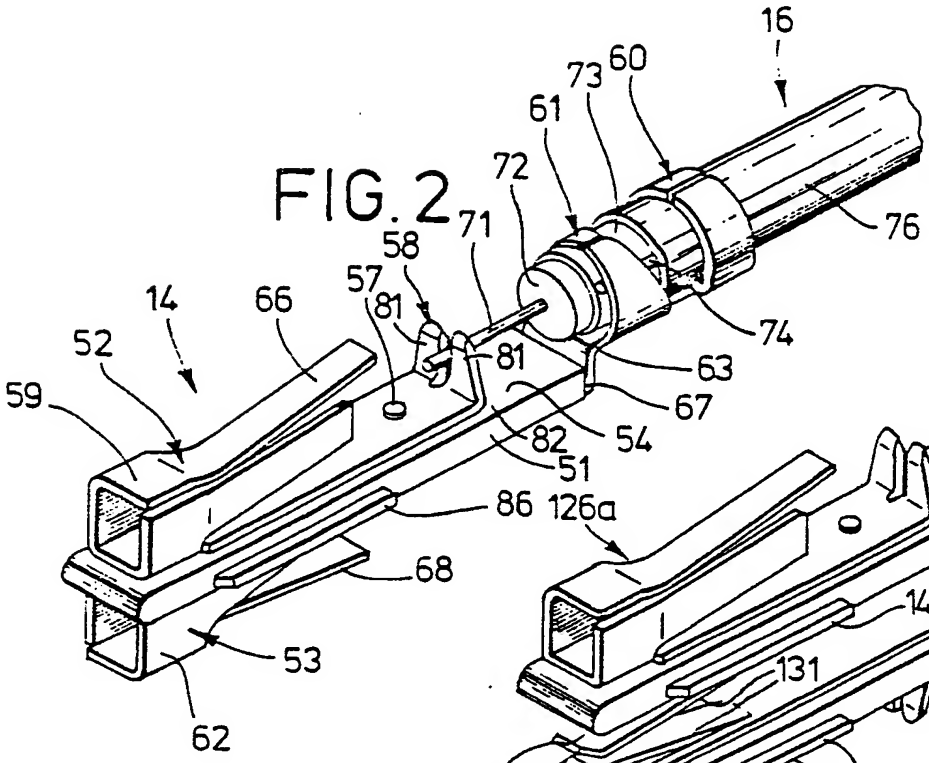

FIG. 2

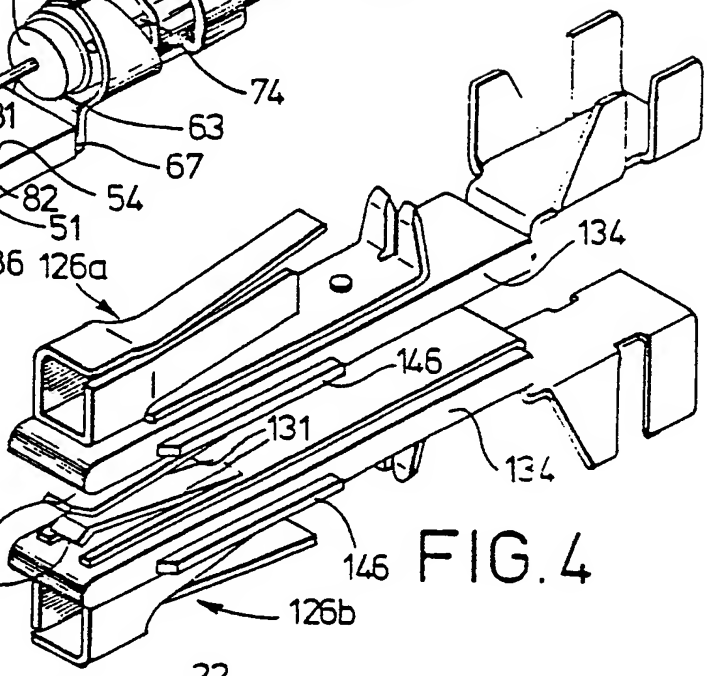

FIG. 4

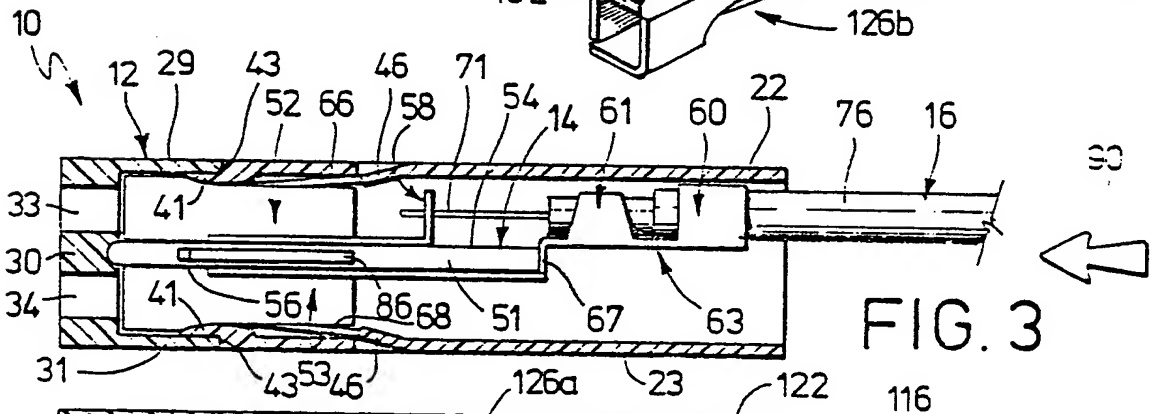

FIG. 3

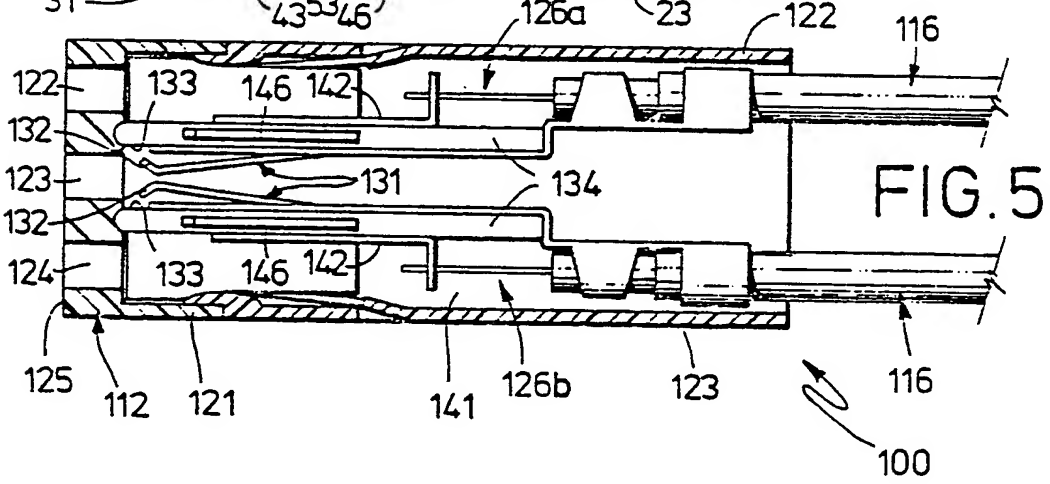

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 2072

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	IBM TECHNICAL DISCLOSURE BULLETIN, vol. 7, no. 11, April 1965, page 989, New York, US; J.L.HORVATH: "Coaxial wire termination" * Page 989 * ---	1,2,4,6,7,9	H 01 R 9/05 H 01 R 9/07
A	US-A-3 824 528 (ESSER) * Column 1, line 51 - column 2, line 34; figures 1-4 * ---	1,4	
A	EP-A-0 072 063 (E.I. DU PONT) * Pages 2-4; figures 1-8 * -----	1-9	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

H 01 R 9/00
H 01 R 13/00
H 01 R 23/00
H 01 R 4/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-05-1988	TAPPEINER R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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